
LEECHES FOUND ON TWO SPECIES OF *HELISOMA* FROM FLEMING'S CREEK, MICHIGAN¹

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ABSTRACT

A survey of leeches in three genera of gastropods collected from Fleming's Creek, near Ypsilanti, Michigan, revealed a selective association between the smaller leech *Helobdella papillata* and the smaller snail, *Helisoma anceps*, and between the larger leech *Helobdella lineata* and the larger snail *Helisoma trivolvis*. In addition, a few individuals of the leech *Glossiphonia complanata* were found on both helisomid snails, and this species, together with nine other species of leeches, was also found either free-swimming or attached to substrate other than one of these snails.

INTRODUCTION

A study was conducted in a small section of Fleming's Creek, near Ypsilanti, Michigan, to determine, for that area, which species of leeches occur most frequently on which species of larger pulmonates. Past studies on leech-snail relationships were of two types. In the first category, the researcher collected known species of leeches on unidentified snails (Castle, 1900; Moore, 1912; Miller, 1929), the results indicating that, under natural conditions, certain leeches attach to snails in what was presumed to be a predator-prey relationship. In the second category, the investigators, using the experimental approach, placed known species of snails in aquaria with known species of leeches (Elliot, 1917; Bennike, 1943; Chernin, 1956; Moore, 1964; Sawyer, 1966). These investigations revealed that certain leeches attacked certain snails when both were confined in an aquarium, though there may have been some discrimination by the leeches when given a choice of gastropod species, and also that leeches were more inclined to attack without discrimination after a period of fasting.

The present study, in contrast to the other two types, provides both identifications of both the leeches and snails collected and information on the percent

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frequency of occurrence of each leech species with each snail. These data show precisely which species of leeches attack which species of snails in nature in this area, and make possible the interpretation of some predator-prey relationships.

PROCEDURE

Species of the snail genera *Helisoma*, *Stagnicola*, and *Physa* were collected from Fleming's Creek in Washtenaw County, Michigan (SE $\frac{1}{4}$ of Sec. 25, T2S, R6E), a few miles from the campus of Eastern Michigan University. One hundred and six *Helisoma anceps* (Menka, 1830), 104 *Helisoma trivolvis* (Say, 1817), 102 *Stagnicola* cf. *palustris* (Mueller, 1774), and 105 *Physa* cf. *gyrina* (Say, 1821) were collected from mid-April to early June, 1968, at numerous points along the creek, about 100 yards above the Geddes Road dam. The collecting area included about 100 square yards of the marsh adjacent to the dam and about 40 yards of the stream below the Dam.

As each specimen of gastropod was collected, it was examined for attached leeches and was then placed, individually, in a separate plastic sandwich bag. The snails were removed from the plastic bags in the laboratory and were dissected under a standard binocular dissecting microscope. The keys used to identify the leeches were written by Moore (1959) and by Mann (1962). The leech identifications were confirmed by Dr. Bert M. Johnson of Eastern Michigan University. The snails were identified by Dr. Gary Pace, of the Mollusca Division of the Museum of the University of Michigan, Ann Arbor, Michigan.

RESULTS

All leeches were found on either *Helisoma trivolvis* or *Helisoma anceps*; no leeches were found on any of the specimens of *Stagnicola* or *Physa* (Tables 1, 2, and 3). In Table 1, the individual frequencies of occurrence of the different species of leeches infecting *H. trivolvis* and *H. anceps* are presented in the upper half of each square. This percent frequency of occurrence is derived by dividing the number of leeches of a given species by the total number of snails of a given species collected and multiplying the quotient by 100.

These data on the percent frequency of occurrence (Table 1) show that, out of 106 specimens of *Helisoma anceps* collected, 24.5% (26) were infected with the leech, *Helobdella papillata* (Moore, 1906), 9.9% were infected with *Glossiphonia complanata* (L.), and 0.9% were infected by the leech, *Helobdella lineata* (Verill, 1874). This gives a total frequency of 26% occurrence of leeches in the specimens of *Helisoma anceps* sampled. On the other hand, of the 104 specimens of *Helisoma trivolvis* collected, only 1.9% (2) had the leech *Helobdella papillata*, 23% were

TABLE 1
Percent frequency of occurrence, number, and species of leeches
found on 106 *H. anceps* and 104 *H. trivolvis*.

Species	<i>H. papillata</i>	<i>H. lineata</i>	<i>G. complanata</i>	Total
<i>H. anceps</i>	26/106=24.5%	1/106=0.9%	1/106=0.9%	28/106=26%
	48/50=96%	1/50=2%	1/50=2%	50/50=100%
<i>H. trivolvis</i>	2/104=1.9%	24/104=23%	1/104=1%	27/104=26%
	2/52=3.8%	49/52=94%	1/52=2.2%	52/52=100%
Total	28/210=13%	25/210=12%	2/210=1%	55/210=26%
	50/102=49%	50/102=49%	2/102=2%	102/102=100%

Key:

No. of snails infected ÷ No. of snails sampled x 100 = % frequency of occurrence

No. of leeches ÷ total no. of leeches found on that species of snail x 100 = % of total

infected with *Helobdella lineata*, and 0.9% were infected with *Glossiphonia complanata*. Total frequencies of occurrence of these leeches on the two species of *Helisoma* collected are 13%, 12%, and 1% for *Helobdella papillata*, *Helobdella lineata*, and *Glossiphonia complanata*, respectively.

The lower half of each square in Table 1 contains the number of leeches of a particular species found divided by the total number of leeches found on a given species of snail. These data show that fifty leeches were found on *Helisoma anceps*, of which 96% (48) were *Helobdella papillata*, 2% were *Helobdella lineata*, and 2% were *Glossiphonia complanata*. Fifty-two leeches were found on *Helisoma trivolvis*, of which 94% (49) were *Helobdella lineata*, 3.8% (2) were *Helobdella papillata*, and 2.2% (1) were *Glossiphonia complanata*. The total number of leeches found on both species of snails shows that *Helobdella papillata* and *Helobdella lineata* each contribute 49% and *Glossiphonia complanata* only 2% of the total number of leeches found. It is obvious (Table 1) that multiple infection occurred.

The distribution of leech species found on the specimens of *Helisoma anceps* and *Helisoma trivolvis* collected are presented separately (Tables 2 and 3). Of the

TABLE 2
Distribution of leeches among 106 Helisoma anceps

Number of leeches/snails	0	1	2	3	4	Total
Number of snails	78	14	9	2	3	106
Number of leeches	0	14	18	6	12	50

TABLE 3
Distribution of leeches among 104 Helisoma trivolvis.

Number of leeches/snails	0	1	2	3	4	5	11	Total
Number of snails	77	17	6	1	1	1	1	104
Number of leeches	0	17	12	3	4	5	11	52

TABLE 4
Hirudinea found freeswimming or attached to various substrates, other than to snails, in Fleming's Creek, Michigan (courtesy of Donald Klemm, graduate assistant at Eastern Michigan University).

Family	Species
Glossiphoniidae	1. <i>Glossiphonia complanata</i> (L.)
	2. <i>Helobdella stagnalis</i> (L.)
	3. <i>Placobdella ornata</i> (Verrill, 1872)
	4. <i>Placobdella papillifera</i> (Verrill, 1872)
Hirudidae	5. <i>Macrobdella decora</i> (Say, 1824)
	6. <i>Haemopsis lateralis</i> (Say, 1824)
	7. <i>Haemopsis grandis</i> (Verrill, 1874)
Erpobdellidae	8. <i>Mooreobdella buccera</i> (Moore, 1947)
	9. <i>Erpobdella punctata</i> (Leidy, 1870)
	10. <i>Dina ferrida</i> (Verrill, 1874)

28 specimens of *Helisoma anceps* infected with leeches, 14 (50%) of them were infected with two leeches, 2 (7%) were infected with three leeches, and 3 (10%) were infected with four leeches. From Table 3, it may be seen that 10 (37%) out of the 27 specimens of *Helisoma trivolvis* were multiply infected. Six (22%) of these snails were infected with two leeches. Four others were infected with more (3, 4, 5, and 11) leeches.

Of the 50 leeches found on *Helisoma anceps*, 42% (21) were found beneath the mantle, all of which were *Helobdella papillata*. Two of these were found as far up inside the snail as the tip of the ovotestis. No leeches were found under the mantle of *Helisoma trivolvis*. Leeches not found below the mantle were

attached between the mantle and the shell, or attached to the plastic bag in which the snail was transported from the field to the laboratory.

Leeches collected in the same area and at the same time as the snails were collected are listed in Table 4. Ten species representing three families were found free swimming or attached to various substrates other than to snails. Three species of the family Glossiphoniidae, *Helobdella papillata*, *Helobdella lineata*, and *Glossiphonia complanata*, were found on *Helisoma anceps* and *Helisoma trivolvis*. The leech *Glossiphonia complanata* was the only species found both on and off snails.

The specimens of *Stagnicola* and *Physa* that were collected exhibited a high incidence of trematode infection. No leeches were found on these snails. It is tempting to speculate that it is this trematode infection which might partially account for the absence of leeches in these populations of *Stagnicola* and *Physa*.

DISCUSSION

The results of this study suggest that certain leeches found in Fleming's Creek are selective for members of the genus *Helisoma*, and appear to avoid members of the genera *Stagnicola* or *Physa*, at least those with intense trematode infections. Though many leeches of the family Glossiphoniidae have been reported, under laboratory conditions, to be predators of many species of snails, including representatives of the genera *Stagnicola* and *Physa* (Bennike, 1943; Moore, 1964), these laboratory-feeding experiments do not contradict my field-determined results.

Though *Helobdella papillata* and *Helobdella lineata* occurred in practically equal numbers and much more frequently on snails than did *Glossiphonia complanata*, *G. complanata* was frequently found attached to rocks and various substrates, whereas *Helobdella papillata* and *H. lineata* were found only on snails. Therefore, the differences in the frequencies of occurrence of the three leeches on the snails examined are probably a function of differences in selectivity towards snails as a food source and not as a function of differences in population sizes of the leeches.

The results, summarized in Table 1, suggest a specificity of association between *Helobdella papillata* and *Helisoma anceps* and between *Helobdella lineata* and *Helisoma trivolvis*. Contingency tables were developed to check the statistical significance of the data, using Chi-square as a test of association (see Appendix for calculations and formulae used). The Chi-square values for *Helobdella papillata*-*Helisoma anceps* and *Helobdella lineata*-*Helisoma trivolvis* were 21 and 17, respectively. Chi-square values of this magnitude for one degree of freedom indicated that the probability of these associations occurring by chance is insignificant. This ultimately suggests, then, that for the Fleming's Creek area, *Helobdella papillata* is highly selective for *Helisoma trivolvis* and *Helobdella lineata* for *Helisoma anceps*.

Multiple infection of snails by *Helobdella papillata* occurred more often (50% of the time) than did multiple infection by *Helobdella lineata* (37%). An explanation for this difference in multiple infection might be overcrowding within the snail or the snail's ability or lack of ability to withstand predation. However, this does not seem reasonable because the specimens of *Helobdella papillata* infecting snails were approximately one-half the size of those of *Helobdella lineata*. Then too, *Helobdella papillata* almost always infected a snail, *Helisoma anceps*, which was approximately one-half the size of the snail, *Helisoma trivolvis*.

Young specimens of Glossiphoniidae are reported (Mann, 1962) to live for long periods of time in the mantle cavity of some of the larger freshwater snails. In this study, no leeches were found in the mantle cavity, proper, of either *Helisoma anceps* or *Helisoma trivolvis*. However *Helobdella papillata* was found below the mantle in 42% of the specimens of *Helisoma anceps*, whereas the larger leech, *Helobdella lineata*, was never found below the mantle of either species of snail. It would seem that the small size of *Helobdella papillata* accounts both

for the sub-mantle location of its infections and for its relative restriction to the smaller *Helisoma anceps*, whereas the larger size of *Helobdella lineata* made sub-mantle infection impossible and generally restricted its preying to the larger *Helisoma trivolvis*. Additional meaningful speculation regarding the cause of this selectivity would require further investigation.

The species diversity of leeches in Fleming's Creek is obviously high (Table 4). Yet the number of different species of leeches found infecting snails is low, and is limited to two species of one genus and one species of another genus of the family Glossiphoniidae.

SUMMARY

The results of this survey of leeches infecting snails in a small section of Fleming's Creek, Michigan, can be summarized as follows.

1. Members of the genus *Helisoma* are preferred as a prey by certain leeches over *Stagnicola* or *Physa*.

2. *Helobdella papillata* and *Helobdella lineata* make up the majority of the leeches found on specimens of *Helisoma*.

3. There seems to exist a selective association between *Helobdella papillata* and *Helisoma anceps*, and between *Helobdella lineata* and *Helisoma trivolvis*.

4. Multiple-leech infection occurs in both *Helisoma anceps* and *Helisoma trivolvis*, but dominantly in *Helisoma trivolvis*.

5. The leech *Helobdella papillata* was frequently found beneath its host's mantle, whereas *Helobdella lineata* was never found below the snail's mantle.

APPENDIX

APPENDIX TABLE 1. 2 x 2 contingency table for a test of association by X^2 of *Helisoma anceps* with *Helobdella papillata*. Calculations adapted from Simpson (1960) and Cox (1967).

	<i>Helisoma anceps</i>		Totals
	Present	Absent	
A. = 14.1	a = 26	b = 2	a + b = 28
C. = 91.9	c = 80	d = 102	c + d = 182
Totals	a + c = 106	b + d = 104	210

Key	
Theoretical frequencies	
Observed frequencies	

<i>Helobdella papillata</i>	Absent	Present
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Calculations from Appendix Table 1

i. Coefficient of association:

$$\text{when } ad \geq bc, C = \frac{ad - bc}{(a+b)(b+d)} = \frac{2492}{2912} = .86$$

ii. Expected frequencies in chance association:

Number of snails infected with *Helobdella papillata* x Number of *Helisoma anceps*

$$\frac{28 \times 106}{210} = 14.1, \text{ from this the other three values are obtained by subtraction from the totals.}$$

iii. Calculation of X^2

$$X^2 = \frac{[(ad - bc) - .5T]^2(T)}{(a+b)(a+c)(b+d)(c+d)} = \frac{[(26 \cdot 102 - 2 \cdot 80) - .5 \cdot 210]^2(210)}{(26+2)(26+30)(2+102)(80+102)} = 21 \text{ for one degree of freedom}$$

APPENDIX TABLE 2. 2 x 2 contingency table for a test of association by X^2 of *Helisoma trivolvis* with *Helobdella lineata*.

		<i>Helisoma trivolvis</i>		Totals
		Present	Absent	
	A. = 13.3	B. = 13.7		
	a = 24	b = 3		a + b = 27
	C. = 90.7	D. = 92.3		
	c = 80	d = 103		c + d = 183
Totals	a + c = 104	b + d = 106		210

Key:

Theoretical frequencies

Observed frequencies

<i>Helobdella lineata</i>		Absent	Present
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Calculations from Appendix Table 2

i. Coefficient of association:

$$\text{when } ad \geq bc, C = \frac{ad - bc}{(a + b)(c + d)} = \frac{2232}{4941} = .45$$

ii. Expected frequencies in chance association:

$$\frac{\text{Number of snails infected with } \textit{Helobdella lineata}}{\text{Total number of snails}} \times \text{Number of } \textit{Helisoma trivolvis}$$

$$\frac{27 \times 104}{210} = 13.3$$

iii. Calculation of X^2

$$X^2 = \frac{[(ad - bc) - .5T]^2(T)}{(a + b)(a + c)(b + d)(c + d)} = \frac{[(24 \cdot 103 - 3 \cdot 80) - .5(210)]^2}{(24 + 3)(24 + 80)(3 + 103)(80 + 103)} = 17 \text{ for one degree of freedom.}$$

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